Project: Networks Reliability

Reliability is the quality of being trustworthy or performing consistently well. This performance may concern different aspects of a system's operation. In the case of transportation networks, two main reliability performances are studied: travel time reliability and connectivity reliability.

Connectivity reliability concerns the accessibility performances in the network, while travel time reliability studies the variability in travel time. It argues that traffic congestion is common in many cities, and in these cities, drivers are accustomed to congestion. They expect and plan for some delay, particularly during peak driving times. They need to adjust their schedules or budget extra time to allow for traffic delays.

The objective of this project is to study different ways to measure travel time reliability and to analyze the best way to take into account to guarantee being on time in most instances, despite the congestion.
In paper [1], authors studied the impact of a management strategy, namely on-ramp metering, on travel time reliability. They used different reliability indicators to measure travel time reliability before and after the application of the ramp metering strategy. In your project, you will apply these indicators to a public transportation network and analyze their objective.

Part 1: Main indicators

1. Read the paper and analyze the different indicators.

2. Load the matrix containing 50 **T**ravel **T**imes of the bus network in "TT_link.mat" *(based on "Route.mat" used in tutorials)*. This matrix provides the travel time (in minutes) between two consecutive bus stops on a given bus route when a bus route is linking these stops.

3. Compute the shortest travel time using the Dijkstra algorithm from any origin to any destination of the network to build a "TT_OD" matrix for the 50 samples of the TT_link 3D-Matrix.

4. Compute all the key performance indicators given in the paper *(named COV, TT10, TT50, TT80, TT90, TT95, λ^{var}, λ^{dev} , UI_r, BI, PTI, MI, Pr(TTi>B+TT50) in the paper)*. Where TT80/ TT90, TTk… is the 80^{th} / 90^{th} / k^{th} ... percentile, also known as percentile score or centile.

   A 5% percentile could be chosen to define the *freeflow Travel time*. To define the route length L_r let consider a 15km/h mean speed together with the free flow travel time.

5. Comment key performance indicators results. Which index will you use if you were a regular user compared to an occasional user.

Part 2: Value of time

1. Considering values of time (VOT) given on Table 1 and using the VOT for the case *"without a specific purpose"* in the Île-de-France area, calculate the maximum and minimum time-savings benefits in the worst and best situation in the samples of the TT_OD matrix compared to the initial conditions.

2. Analyze and comment results linked to the monetary waste of time due to reliability of travel time.

Table 1: Value of Time in €/hour in France in 2015
(extracted from: Chiffres clés des transports - Édition 2021, Ministères Écologie Énergie Territoires)

Trip purpose	Average in France	Ile-de-France only *(Paris and suburbs)*
Professional	18.6	23.7
Home-to- work/school/university	10.6	13.4
Others *(shopping, care, visit, leisure…)*	7.2	9.3
Without details of the trip purpose	8.4	11.4

Bibliography
[1] *Bhouri N. and Kauppila, J. "Managing Highways for Better Reliability – Assessing Reliability Benefits of Ramp Metering". Transportation Research Record, Journal of the Transp. Research Board N°2229. Pp1-7. DOI : 10.3141 /2229-01, 2011.*
Available at ***https://hal.science/hal-01483591/document***